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(54) **OPTICAL SYSTEMS WITH MULTI-LAYER HOLOGRAPHIC COMBINERS**

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(57) **ABSTRACT**

An electronic device may include a display module that generates image light and an optical system that redirects the light towards an eye box. The optical system may have first hologram structures that replicate the light over multiple output angles onto second hologram structures. The second hologram structures may focus the replicated light onto the eye box. If desired, the device may include an image sensor. The first and second hologram structures may include transmission and/or reflection holograms. The optical system may redirect a first portion of the light to the eye box and a second portion of the light to the sensor. The sensor may generate image data based on the second portion of the light. Control circuitry may compensate for distortions in the first portion of the light by performing feedback adjustments to the display module based on distortions in the image data.